Marine Physical Laboratory

Spatial/Temporal Signal and Noise Analysis and Site Specific Experiment Support

William S. Hodgkiss

Final Report to the
Office of Naval Research
Contract N00014-89-D-0142 (DO #30)
for the Period 5-15-92 - 5-14-93

Final Report

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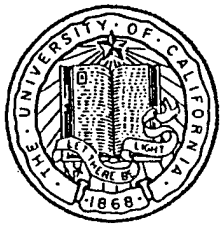

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Little experimental data exists which can be applied to the design and performance evaluation of multidimensional array systems. Such data are needed both to validate signal and noise propagation models as well as to provide well-documented real data inputs to new adaptive spatial and temporal processing algorithms. In preparation for a FY94 VLF noise and signal experiment, preliminary analysis of an existing near-seafloor data set was carried out, planning and preparation for a September 1993 engineering sea test were completed, and robust adaptive algorithms were developed for the processing of array data.

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Abstract

Little experimental data exists which can be applied to the design and performance evaluation of multidimensional array systems. Such data are needed both to validate signal and noise propagation models as well as to provide well-documented real data inputs to new adaptive spatial and temporal processing algorithms. In preparation for a FY94 VLF noise and signal experiment, preliminary analysis of an existing near-seafloor data set was carried out, planning and preparation for a September 1993 engineering sea test were completed, and robust adaptive algorithms were developed for the processing of array data.

Research Objectives

The objective of this program was to assist NOSC (now NRaD) in the preparations required for a VLF noise and signal experiment in FY94.

Research Summary

As envisioned, the experiment that was to be conducted in FY94 would provide a multidimensional array data set along with detailed

environmental data including water column sound speed structure and a geoacoustic characterization of the bottom. Preparations for the FY94 experiment involved several efforts.

First, in order to obtain an example of near-seafloor vertical array data, the NOBS (Noise On Basalt and Sediment) experiment was augmented with 48 hydrophone array elements providing data on ambient noise and signal structure from the seafloor to approximately 750 m above. Analysis of this data is documented in [1].

Second, MPL assisted NOSC in planning the FY94 Site Specific Experiment (SSE). This included participation in discussions concerning the ocean engineering requirements for array deployment and recovery, site selection, and development of the scientific objectives and data requirements for the experiment. Also, as part of this effort, MPL participated in the planning and preparations for the SSE engineering sea test which was carried out in September 1993.

Third, robust adaptive algorithms have been developed for the processing of multidimensional array data. Uncertainties in environmental parameters (e.g. water column sound speed structure or geoacoustic properties of the bottom) can lead to degradations in the performance of adaptive beamformers. Incorporating knowledge of this uncertainty can improve substantially adaptive beamformer performance. One approach to the design of such a robust processor in a matched-field framework is described in [2]. The MV-SPC (Minimum Variance with Sound-speed Perturbation Constraints) processor then is extended in [3] to include wavefront measurements from a source-of-opportunity leading to additional improvement in performance.

ONR Publications

[1] M.T. Hagerty, G.L. D'Spain, and W.S. Hodgkiss, "Preliminary analysis of the FLIP Array Data from the NOBS Experiment," MPL TM-429, Marine Physical Laboratory of the Scripps Institution of Oceanography, San Diego, CA (1992).

[2] J. Krolik, "Matched-field minimum variance beamforming in a random ocean channel," J. Acoust. Soc. Am. 92: 1408-1419 (1992).

[3] J.L. Krolik, "Self-cohering conditionally constrained minimum variance matched-field processing in a random ocean environment," J. Acoust. Soc. Am. 93(4): 2375 (1993).

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